

IN THE CLAIMS:

1. (Currently amended) A pneumatically-powered mine door installation comprising:

a mine door frame installed in a mine passageway;

5 at least one door leaf mounted on the mine door frame for swinging movement between open and closed positions for opening and closing the door installation, said door leaf having a first face that is subject to relatively higher air pressure and a second face that is subject to relatively lower air pressure when the door installation is closed;

10 an extensible and retractable pneumatically-powered actuator mounted with a first end connected to the at least one door leaf and a second end connected to a pneumatic actuator anchor so that extension and retraction of the actuator causes the door leaf to swing back and forth between its open and

15 closed positions; and

a hydraulic checking system for controlling the speed of the at least one door leaf as it moves ~~back and forth~~ between its open and closed positions.

2. (Currently amended) The door installation of claim 1 wherein said hydraulic checking system comprises:

a housing containing hydraulic fluid;

5 a piston in the housing separating the interior of the housing into a blind end fluid chamber containing a first volume of hydraulic fluid and a rod end fluid chamber containing a second volume of hydraulic fluid;

a rod extending through an opening in the housing wherein one end of the rod is connected to the piston in the housing 10 and the other end of the rod is exterior of the housing,

a hydraulic circuit providing fluid connection between the first and second fluid chambers, said hydraulic circuit having one or more fluid flow restrictions for providing resistance to flow of hydraulic fluid through the hydraulic circuit; and

15 the piston and rod being slidable along a sliding axis of the housing to allow extension and retraction of the rod with respect to the housing, the rod being connected to either the door leaf or a hydraulic checking system anchor and the housing being connected to the other of the door leaf and the hydraulic
20 checking system anchor so that swinging movement of the door leaf causes the rod to extend or retract with respect to the housing, said extension or retraction of the rod requiring hydraulic fluid to flow through said one or more fluid flow restrictions.

3. (Original) The door installation of claim 2 wherein at least one fluid flow restriction comprises an adjustable needle valve.

4. (Original) The door installation of claim 2 wherein said one or more fluid flow restrictions comprise a first adjustable fluid flow restriction for adjusting the opening speed of the door leaf and a second adjustable fluid flow 5 restriction for adjusting the closing speed of the door leaf.

5. (Original) The door installation of claim 4 wherein the first and second adjustable fluid flow restrictions comprise adjustable needle valves.

6. (Original) The door installation of claim 2 wherein said hydraulic checking system further comprises a pressurized hydraulic fluid reservoir for storing a surplus of hydraulic fluid, the pressurized fluid reservoir being in fluid

5 connection with the hydraulic circuit, said pressurized hydraulic fluid reservoir being operable to prevent pressure in the housing from dropping below ambient air pressure when the rod retracts with respect to the housing.

7. (Original) The door installation of claim 6 wherein compressed air is used to pressurize the pressurized hydraulic fluid reservoir.

8. (Original) The door installation of claim 6 wherein said pressurized hydraulic fluid reservoir is also operable to receive a volume of hydraulic fluid displaced from the housing when the rod retracts and to supply a volume of hydraulic 5 corresponding to the displacement of the rod to the housing when the rod extends.

9. (Cancelled).

10. (Currently amended) The door installation of claim 2 9 wherein the stroke of the rod as the at least one door leaf moves from its closed to its open position is less than the stroke of the pneumatic actuator as the at least one door leaf 5 moves from its closed position to its open position.

11. (Currently amended) The door installation of claim 2 9 wherein the pressure on the first face of the door leaf and the pressure on the second face of the door leaf substantially equalize when the door leaf is at an intermediate point on the path from its closed position to its open position, and wherein 5 the locations for the hydraulic checking system anchor and connection of the hydraulic cylinder to the door leaf are such that the ratio of the angular velocity of the door leaf to the rate at which the rod moves with respect to the hydraulic

10 housing is substantially minimized as the door leaf reaches said intermediate point.

12. (Original) The door installation of claim 11 wherein the hydraulic checking system is anchored to a bracket welded to the pneumatic actuator.

13. (Currently amended) The door installation of claim 2 ~~9~~ wherein the location of the hydraulic checking anchor is selected so the ratio of the angular velocity of the door leaf to the rate at which the rod moves with respect to the 5 hydraulic housing generally decreases as the door leaf moves along a substantial portion of the path from its closed position to its open position.

14. (Currently amended) The door installation of claim 2 ~~9~~ wherein the location of the hydraulic checking system anchor is selected so the line of action of the hydraulic checking system is substantially parallel to the at least one door leaf 5 when the door leaf is in its closed position.

15. (Currently amended) The door installation of claim 2 ~~9~~ wherein the hydraulic checking system anchor comprises a bracket welded to a column of the door frame.

16. (Currently amended) The door installation of claim 2 ~~9~~ wherein the locations for the hydraulic checking system anchor and connection of the rod to the door leaf are selected so the sliding axis of the hydraulic system is substantially 5 perpendicular to the door leaf when the at least one door leaf has been moved between 0 and 10 degrees from its closed position to its open position.

17. (Original) The door installation of claim 1 wherein the pneumatic actuator is mounted so its leverage in opening the at least one door leaf is substantially at its maximum when the at least one door leaf is in its closed position.

18. (Currently amended) The door installation of claim 1 wherein the pneumatic actuator is mounted so the ratio of the angular velocity of the at least one door leaf to the rate at which the first end rod of the pneumatic actuator moves with respect to the second end of the pneumatic actuator housing generally increases as the door leaf moves along a substantial portion of the path from its closed position to its open position.
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19. (Original) The door installation of claim 1 wherein the door leaf opens by swinging toward the high pressure side of the door leaf.

20. (Currently amended) A pneumatically-powered mine door installation for operation in a mine with an air ventilation system, said door installation comprising:

a mine door frame installed in a mine passageway;
5 first and second door leafs mounted on opposite sides of the mine door frame for swinging movement between open and closed positions, each door leaf having a first face that is subject to relatively higher air pressure and a second face that is subject to relatively lower air pressure when the first and second door leafs are in their closed positions;
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for each of the first and second door leafs an extensible and retractable pneumatically-powered actuator mounted with a first end connected to the respective door leaf and a second end connected to a pneumatic actuator anchor so that extension

15 and retraction of the actuator causes the respective door leaf to swing back and forth between its open and closed positions; and

20 a hydraulic checking system for controlling the speed of the first and second door leafs as they swing ~~back and forth~~ between their open and closed positions.

21. (Original) The door installation of claim 20 wherein said hydraulic checking system comprises:

first and second housings containing hydraulic fluid;
a first piston within the first housing and a second
5 piston within the second housing, each of the first and second pistons separating the interior of a respective housing into a first fluid chamber containing a first volume of hydraulic fluid and a second fluid chamber containing a second volume of hydraulic fluid;

10 a hydraulic circuit providing fluid connection between the first and second fluid chambers of each housing, said hydraulic circuit having one or more fluid flow restrictions for providing resistance to flow of hydraulic fluid through the hydraulic circuit; and

15 a first rod extending through an opening in the first housing having one end connected to the first piston and the other end on the exterior of the first housing and a second rod extending through an opening in the second housing having one end connected to the second piston and the other end on the
20 exterior of the second housing,

each piston and rod being slidable along a sliding axis of a respective housing to allow extension and retraction of the rod with respect to the housing, said extension and retraction of either rod requiring hydraulic fluid to flow through the one

25 or more fluid flow restrictions, each rod being connected to either the respective door leaf or a hydraulic checking system anchor and each housing being connected to the other of the respective door leaf or the hydraulic checking system anchor so that swinging movement of the first and second door leafs
30 causes the respective rod to extend or retract with respect to its housing.

22. (Currently amended) The door installation of claim 21 wherein the one or more fluid flow restrictions comprise:

a first adjustable fluid flow restriction capable of adjusting the amount of force countering extension of the first 5 and second rods with respect to the first and second housings independent of the amount of force countering retraction of the first and second rods with respect to the first and second housings; and

a second adjustable fluid flow restriction capable of 10 adjusting the amount of force resisting retraction of the first and second rods with respect to the first and second housings independent of the amount of force countering extension of the first and second rods with respect to the first and second housings.

23. (Original) The door installation of claim 22 wherein the first and second adjustable fluid flow restrictions comprise adjustable needle valves.

24. (Original) The door installation of claim 21 wherein the one or more fluid flow restrictions comprise:

a first adjustable fluid flow restriction capable of adjusting the amount of force countering extension and 5 retraction of the first rod with respect to the first housing

independent of the amount of force counteracting extension and retraction of second rod with respect to the second housing; and
and a second adjustable fluid flow restriction capable of adjusting the amount of force resisting extension and
10 retraction of the second rod with respect to the second housing independent of the amount of force resisting extension and retraction of the first rod with respect to the first housing.

25. (Original) The door installation of claim 24 wherein the first and second adjustable fluid flow restrictions comprise adjustable needle valves.

26. (Original) The door installation of claim 24 wherein the first and second adjustable fluid flow restrictions are adjustable to establish a closing sequence for the first and second door leafs.

27. (Original) The door installation of claim 21 wherein the one or more fluid flow restrictions comprise:

a first adjustable fluid flow restriction capable of adjusting the amount of force counteracting extension of the first and second rods with respect to the first and second housings
5 independent of the amount of force counteracting retraction of the first and second rods with respect to the first and second housings;

10 a second adjustable fluid flow restriction capable of adjusting the amount of force resisting retraction of the first and second rods with respect to the first and second housings independent of the amount of force counteracting extension of the first and second rods with respect to the first and second housings;

15 a third adjustable fluid flow restriction capable of adjusting the amount of force counteracting extension and

retraction of the first rod with respect to the first housing independent of the amount of force countering extension and retraction of second rod with respect to the second housing; and
and a fourth adjustable fluid flow restriction capable of
20 adjusting the amount of force resisting extension and retraction of the second rod with respect to the second housing independent of the amount of force resisting extension and retraction of the first rod with respect to the first housing.

28. (Original) The door installation of claim 27 wherein the adjustable fluid flow restrictions comprise adjustable needle valves.

29. (Original) The door installation of claim 27 wherein the third and fourth fluid flow restrictions are adjustable to establish a closing sequence for the first and second door leafs.

30-35 (Cancelled).

36. (New) The door installation of claim 1 wherein the hydraulic checking system is operable to control the speed of the at least one door leaf as it moves from its closed position 5 toward its open position and from its open position toward its closed position.

37. (New) The door installation of claim 20 wherein the hydraulic checking system is operable to control the speed of the first and second door leafs as they move from their closed positions toward their open positions and from their open 5 positions toward their closed positions.

38. (New) A pneumatically-powered door assembly comprising:

a door frame;
at least one door leaf mounted on the door frame for
5 swinging movement between open and closed positions for opening
and closing the door assembly;
an extensible and retractable pneumatically-powered
actuator mounted with a first end connected to the at least one
door leaf and a second end connected to a pneumatic actuator
10 anchor so that extension and retraction of the actuator causes
the door leaf to swing back and forth between its open and
closed positions; and
a hydraulic checking system for controlling the speed of
the at least one door leaf as it moves between its open and
15 closed positions, the hydraulic checking system comprising:
a housing containing hydraulic fluid;
a piston in the housing separating the interior of the
housing into a blind end fluid chamber containing a first
volume of hydraulic fluid and a rod end fluid chamber
20 containing a second volume of hydraulic fluid;
a rod extending through an opening in the housing wherein
one end of the rod is connected to the piston in the housing
and the other end of the rod is exterior of the housing; and
a hydraulic circuit providing fluid connection between the
25 first and second fluid chambers, said hydraulic circuit having
one or more fluid flow restrictions for providing resistance to
flow of hydraulic fluid through the hydraulic circuit,
the piston and rod being slidable relative to the housing
to allow extension and retraction of the rod with respect to
30 the housing, the rod being connected to either the door leaf or
a hydraulic checking system anchor and the housing being
connected to the other of the door leaf and the hydraulic

35 checking system anchor so that swinging movement of the door leaf causes the rod to extend or retract with respect to the housing, said extension or retraction of the rod requiring hydraulic fluid to flow through said one or more fluid flow restrictions, wherein the stroke of the rod as the at least one door leaf moves from its closed to its open position is less than the stroke of the pneumatic actuator as the at least one door leaf moves from its closed position to its open position.

39. (New) The door assembly of claim 38 wherein said one or more fluid flow restrictions comprise a first adjustable fluid flow restriction for adjusting the opening speed of the at least one door leaf and a second adjustable fluid flow restriction for adjusting the closing speed of the at least one door leaf.

40. (New) The door assembly of claim 38 wherein the hydraulic checking system is anchored to a bracket welded to the pneumatic actuator.

41. (New) The door assembly of claim 38 wherein the location of the hydraulic checking anchor is selected so the ratio of the angular velocity of the at least one door leaf to the rate at which the rod moves with respect to the hydraulic housing generally decreases as the at least one door leaf moves along a substantial portion of the path from its closed position to its open position.

42. (New) The door assembly of claim 38 wherein the location of the hydraulic checking system anchor is selected so the line of action of the hydraulic checking system is substantially parallel to the at least one door leaf when the door leaf is in its closed position.

43. (New) The door assembly of claim 38 wherein the hydraulic checking system anchor comprises a bracket welded to a column of the door frame.

44. (New) The door assembly of claim 38 wherein the pneumatic actuator is mounted so its leverage in opening the at least one door leaf is substantially at its maximum when the at least one door leaf is in its closed position.

45. (New) The door assembly of claim 38 wherein the hydraulic checking system is operable to control the speed of the at least one door leaf as it moves from its closed position to its open position and from its open position to its closed position.

46. (New) A pneumatically-powered door assembly comprising:
a door frame;
first and second door leafs mounted on opposite sides of the door frame for swinging movement between open and closed positions;

for each of the first and second door leafs an extensible and retractable pneumatically-powered actuator mounted with a first end connected to the respective door leaf and a second end connected to a pneumatic actuator anchor so that extension and retraction of the actuator causes the respective door leaf to swing back and forth between its open and closed positions; and

a hydraulic checking system for controlling the speed of the first and second door leafs as they swing between their open and closed positions, the hydraulic checking system comprising:

first and second housings containing hydraulic fluid;
a first piston within the first housing and a second
piston within the second housing, each of the first and second
20 pistons separating the interior of a respective housing into a
first fluid chamber containing a first volume of hydraulic
fluid and a second fluid chamber containing a second volume of
hydraulic fluid; and

a hydraulic circuit providing fluid connection between the
25 first and second fluid chambers of each housing, said hydraulic
circuit having one or more fluid flow restrictions for
providing resistance to flow of hydraulic fluid through the
hydraulic circuit,

a first rod extending through an opening in the first
30 housing having one end connected to the first piston and the
other end on the exterior of the first housing and a second rod
extending through an opening in the second housing having one
end connected to the second piston and the other end on the
exterior of the second housing, each piston and rod being
35 slidable relative to the respective housing to allow extension
and retraction of the rod with respect to the housing, said
extension and retraction of either rod requiring hydraulic
fluid to flow through the one or more fluid flow restrictions,
each rod being connected to either the respective door leaf or
40 a hydraulic checking system anchor and each housing being
connected to the other of the respective door leaf or the
hydraulic checking system anchor so that swinging movement of
the first and second door leafs causes the respective rod to
extend or retract with respect to its housing, wherein for each
45 door leaf the stroke of the respective rod as the door leaf
moves from its closed to its open position is less than the

stroke of the respective pneumatic actuator as the door leaf moves from its closed position to its open position.

47. (New) The door assembly of claim 46 wherein the one or more fluid flow restrictions comprise:

a first adjustable fluid flow restriction capable of adjusting the amount of force countering extension of the first and second rods with respect to the first and second housings independent of the amount of force countering retraction of the first and second rods with respect to the first and second housings; and

10 a second adjustable fluid flow restriction capable of adjusting the amount of force resisting retraction of the first and second rods with respect to the first and second housings independent of the amount of force countering extension of the first and second rods with respect to the first and second housings.

48. (New) The door assembly of claim 46 wherein the one or more fluid flow restrictions comprise:

a first adjustable fluid flow restriction capable of adjusting the amount of force countering extension and retraction of the first rod with respect to the first housing independent of the amount of force countering extension and retraction of second rod with respect to the second housing; and

10 and a second adjustable fluid flow restriction capable of adjusting the amount of force resisting extension and retraction of the second rod with respect to the second housing independent of the amount of force resisting extension and retraction of the first rod with respect to the first housing.

49. (New) The door assembly of claim 46 wherein the first and second adjustable fluid flow restrictions are adjustable to

establish a closing sequence for the first and second door leafs.

50. (New) The door assembly of claim 46 wherein the one or more fluid flow restrictions comprise:

a first adjustable fluid flow restriction capable of adjusting the amount of force countering extension of the first and second rods with respect to the first and second housings independent of the amount of force countering retraction of the first and second rods with respect to the first and second housings;

10 a second adjustable fluid flow restriction capable of adjusting the amount of force resisting retraction of the first and second rods with respect to the first and second housings independent of the amount of force countering extension of the first and second rods with respect to the first and second housings;

15 a third adjustable fluid flow restriction capable of adjusting the amount of force countering extension and retraction of the first rod with respect to the first housing independent of the amount of force countering extension and retraction of second rod with respect to the second housing; and

20 and a fourth adjustable fluid flow restriction capable of adjusting the amount of force resisting extension and retraction of the second rod with respect to the second housing independent of the amount of force resisting extension and retraction of the first rod with respect to the first housing.

51. (New) The door assembly of claim 50 wherein the third and fourth fluid flow restrictions are adjustable to establish a closing sequence for the first and second door leafs.

52. (New) The door assembly of claim 46 wherein the hydraulic checking system is operable to control the speed of the first and second door leafs as they move from their closed positions toward their open positions and from their open 5 positions toward their closed positions.

53. (New) A pneumatically-powered door assembly comprising:
a door frame;

at least one door leaf mounted on the door frame for swinging movement between open and closed positions for opening 5 and closing the door assembly;

an extensible and retractable pneumatically-powered actuator mounted with a first end connected to the at least one door leaf and a second end connected to a pneumatic actuator anchor so that extension and retraction of the actuator causes 10 the door leaf to swing back and forth between its open and closed positions; and

a hydraulic checking system for controlling the speed of the at least one door leaf, said hydraulic checking system comprising:

15 a housing containing hydraulic fluid;
a piston in the housing separating the interior of the housing into a blind end fluid chamber containing a first volume of hydraulic fluid and a rod end fluid chamber containing a second volume of hydraulic fluid;

20 a rod extending through an opening in the housing wherein one end of the rod is connected to the piston in the housing and the other end of the rod is exterior of the housing; and

25 a hydraulic circuit providing fluid connection between the first and second fluid chambers, said hydraulic circuit having one or more fluid flow restrictions for providing resistance to flow of hydraulic fluid through the hydraulic circuit,

the piston and rod being slidable relative to the housing to allow extension and retraction of the rod with respect to the housing, the rod being connected to either the door leaf or a hydraulic checking system anchor and the housing being
30 connected to the other of the door leaf and the hydraulic checking system anchor so that swinging movement of the door leaf causes the rod to extend or retract with respect to the housing, said extension or retraction of the rod requiring hydraulic fluid to flow through said one or more fluid flow restrictions, the location of the hydraulic checking anchor being selected so the ratio of the angular velocity of the door leaf to the rate at which the rod moves with respect to the hydraulic housing generally decreases as the door leaf moves along a substantial portion of the path from its closed
35 position to its open position, and the pneumatic actuator being mounted so the ratio of the angular velocity of the at least one door leaf to the rate at which the first end of the pneumatic actuator moves with respect to the second end of the pneumatic actuator generally increases as the door leaf moves along a substantial portion of the path from its closed
40 position to its open position.
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54. (New) The door assembly of claim 53 wherein said one or more fluid flow restrictions comprise a first adjustable fluid flow restriction for adjusting the opening speed of the door leaf and a second adjustable fluid flow restriction for adjusting the closing speed of the door leaf.

55. (New) The door assembly of claim 53 wherein the location of the hydraulic checking system anchor is selected so the line of action of the hydraulic checking system is

substantially parallel to the at least one door leaf when the
5 door leaf is in its closed position.

56. (New) The door assembly of claim 53 wherein the hydraulic checking system anchor comprises a bracket welded to a column of the door frame.

57. (New) The door assembly of claim 53 wherein the pneumatic actuator is mounted so its leverage in opening the at least one door leaf is substantially at its maximum when the at least one door leaf is in its closed position.